ENGINEERING CASE LIBRARY

ECL 249

# The Rambunctious Rim

A workman changing a flat tire on a large earthmover was injured, eventually losing a leg. The manufacturer was then sued. The case history follows the court hearings, providing details and opinions from both sides of the incident, allowing the student to be a member of the jury who decides the outcome.


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Appreciation is expressed to Eugene Field, Esq., of Kalamazoo, Michigan, for permission to use his files for this engineering case.

# THE RAMBUNCTIOUS RIM (A)

## The Circumstances

On 19 June 1972, the operator of a Euclid R-50 earthmover noticed that the inner tire of a dual set on the right rear axle was flat. Jack Cash, called from the company tire service shop, replaced the valve and inflated the tire to about 50 psi. Under this pressure, the leak was audible. Jack Cash then returned to the shop for a replacement wheel assembly and tire which weighed about 2000 pounds. Upon returning to the earthmover, he parked the service truck alongside the earthmover, jacked it up, rigged a sling and hoist over the outer tire, removed all nuts and clamps and tried to take off the outer tire assembly. Since he could not move it, he hit the tire with a hammer to loosen it. The tire-wheel assembly in the sling swung toward Jack and pushed him against the service truck. Jack's injury resulted in amputation of his right leg at mid-thigh.

A preliminary investigation at the site showed that the rim base of the wheel assembly had split into two pieces.

## Wheel Assembly

The wheel assembly is made of a number of pieces as indicated in Exhibit A1. The assembly is based on the details contained in three U. S. Patents indicated in Exhibit A2.

A steel supplier (one of three used by the rim manufacturer) furnishes the rim base hot rolled in "flat" form but with the basic cross section (flange retaining edge, mounting bevel, and grooves). These "flats" are rolled into hoops which are then welded and sized. The flanges are made from rectangular hot rolled sections which are circled, welded and pressed to final shape. Bead seat bands are made from sections hot rolled to contour, circled, welded and sized. The lock ring is made in the same manner except there is no weld at the point where the ends come together.

During manufacture, each rim component is visually inspected with tapes, gages, and mandrels as necessary. Welds are inspected during manufacture of components and after components have been welded together to form the complete rim base. Inspections are performed by Production personnel with spot check audits by a separate Quality Control department.

When a tire has been properly mounted on an assembly and inflated, the combination is mounted in dual in the arrangement shown in Exhibit A3.

Examination of Failed Assembly

The failed assembly had a nominal width of 15 inches and a diameter of 35 inches. Some dimensions and weights of this assembly are given in Exhibit A4. This specific assembly was fabricated in February 1970.

In order to determine the cause of failure, the carrier of the Workmen's Compensation insurance called in a Mr. Faber (a registered metallurgical and mechanical professional engineer) who submitted a preliminary report (of 5 pages and 14 photographs) on 23 August 1972.

It was obvious that failure of the rim base had occurred with a portion of the base separating from the rest of the rim base. This separation was along the "gutter" rolled in the rim base to accomodate the lock ring (See arrow in Exhibit A4). The failure surface did not always follow the minimum thickness along the gutter but was occasionally part way up the side of the gutter.

When the separated ring was "matched" with the rest of the rim base, it was evident that separation started in the vicinity of the weld which joined the two ends of the hot rolled hoop. This weld was diametrically opposite the bead seat band driver. Once separation started, it proceeded around the periphery until separation was complete. The evidence for this was that the separated ring fit rather snugly in the vicinity of the weld and noticeably less so in the vicinity of the bead seat band driver. In addition, there were a few "splinters" torn from the steel nearer to the bead seat band driver.

Exhibit A5 is a portion of the fracture surface in the vicinity of the weld in the rim base. Observe there is a relatively smooth region in the left portion of the fracture surface. At least ten such regions on the fracture surface had a relatively smooth area with "clamshell" markings surrounded by regions which were relatively rough and "woody" in appearance. One of these regions, adjoining the section partially shown in Exhibit A5, is shown in Exhibit A6.

Mr. Faber believed these ten regions indicated fatigue failure but with some difference. In "classical" fatigue, the smooth area generally extends back to the edge (where failure initiated) whereas the regions in the separated ring had a "hill and valley" appearance at the edge (at the gutter), changing to the smooth area which, in turn, rather abruptly changed to the rough areas.

The "hill and valley" appearance suggested the possibility of cracks of some sort present in the rim base when it was put into service. Consequently, dye penetrant and magnetic particle inspections were conducted with particular attention to the original surface of the gutter. Some results are shown in Exhibits A5 and A6.

A metallographic specimen (MS 1) was taken from the separated ring as indicated in Exhibit A6. What appears to be a crack in Exhibit A7 starts at the place indicated in Exhibit A6 by the magnetic particle inspection, i.e., in the gutter surface at some distance from the edge of the fracture surface. It might be noted that this section of the separated ring was examined with dye penetrant with negative results before trying magnetic particle inspection. This indicates that the "crack" is an inclusion rather than a true crack.

Exhibit A8 shows another region of MS 1 in which an inclusion starts at the fracture surface and runs under the gutter surface. At some distance away there is another inclusion under the gutter surface.

A second metallographic specimen (MS 2) was taken from the separated ring as indicated in Exhibit A5. Magnetic particle inspection showed cracks at the weld but MS 2 was taken at a point where there was no obvious suggestion of a crack or other defect in the separated ring. A seam or fold was evident as shown in Exhibit A9.

A section of the rim base weld was cut from the separated ring by cutting parallel to the original edge surface of the ring and on the "back side" of the specimen shown in Exhibit A5. This specimen was polished and macroetched as shown in Exhibit A10.

Spectrographic and wet chemical analyses indicate the steel was an AISI 1010. Typical microstructure of the steel is shown in Exhibit A11.

A visual examination was conducted on the tapered bead seat. One view of the fracture surface is shown in Exhibit A12. The shoulder end of this section had a certain amount of "dirt" on it (as-received) which disappeared during handling. There was also some rust in this region and some shiny spots (as if the two fracture surfaces had rubbed together). The center and tapered portions of the tapered bead seat appear to have fractured rapidly. The appearance suggests that some portion of the bead seat had failed prior to the final fracture. Failure was at the weld in the bead seat. The failure surface has been viewed from an angle (Exhibit A13). A small crack and a void are apparent in the weld. It is probable that failure of the bead seat started at this point.

Faber's Analysis and Conclusions

Faber questioned the quality of the weld in the rim base since the interface between the two sections being joined was so distinct. The presence of defects (Exhibits A8 and A9) at the fracture surface and an inclusion (Exhibit A7) was strong evidence that the individual failure regions started at such defects, in his opinion.

Faber believed it most likely that the series of failed regions around the periphery started at such defects (which would give high

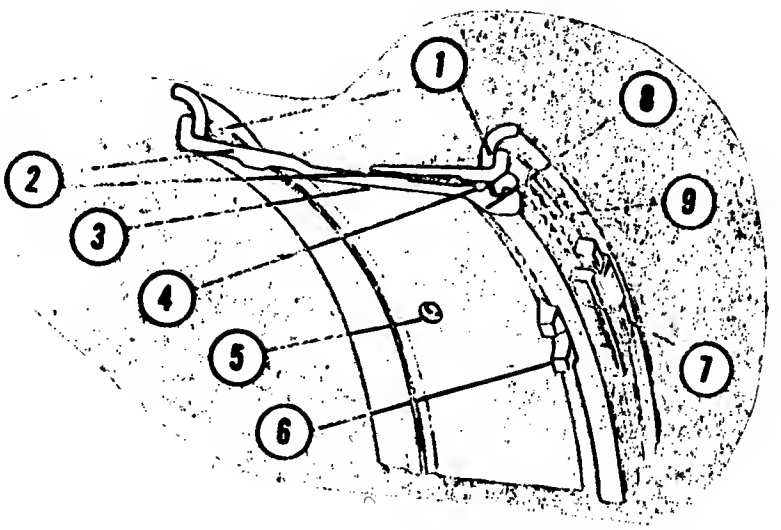
stress concentrations) with failure progressing slowly and intermittently (giving the smooth areas) until the entire rim base was so weakened that it finally completed the failure in a very short time. While the weld was somewhat defective, had cracks in it, and may have been the point of initiation of final failure, such final failure could have started at any one of the regions which had already partially failed. He believed that the condition of the weld only accentuated the problem in that it happened to be the weakest point at the time of final failure.

Faber concluded that both the bead seat and rim base had partially failed prior to final failure of the rim base, which failed by overloading after having been seriously weakened by fatigue. Fatigue was initiated by a series of defects such as inclusions and seams in the steel. The presence of an apparently relatively weak weld simply accentuated the problem. It was his opinion that the rim base would have eventually failed even if the weld were perfect or if there had been no partial failure of the tapered bead seat.

Questions

1. Could the accident have taken place in the manner indicated? What is the basis of your opinion?
2. Do you concur with Mr. Faber? Why (or why not)?
3. What action, if any, should be taken by the insurance company? By Jack Cash? By Cash's employer? By Mr. Faber?


Excerpts from Euclid advertisements to give a sense of scale




1 SIDE FLANGES--two identical cold-formed continuous rings equipped with drivers to prevent circumferential slippage.

2 TAPERED BEAD SEATS--full 5° taper supports entire bead of tire--also knurled to further prevent tire slippage.

3 RIM BASE--double-weld, submerged arc process joins continuous base sections for maximum strength.

4 SEALING RING--famous xxxxxx principle provides positive aire seat.

5 VALVE HOLE--reverse counter bored valve hole located on center line of rim.

6 LOCATING LUG--positions valve stem properly and affords valve protection against loose wheel mounting.

7 HEAVY DUTY BEAD SEAT BAND DRIVER--prevents circumferential slippage under normal operating conditions.

8 STANDARD 28° MOUNTING BEVEL--interchangeable on existing wheels.

9 PRY BAR POCKETS--180° apart on base and bead seat band--used with hydraulic or hand tools to break tire beads loose from bead seat.

Exhibit A1 -- Schematic diagram of multipiece wheel rims for large tubeless tires which may be used on off-highway vehicles such as earthmovers.

U. S. Patent 2,835,303

Application filed 31 October 1955
Patent granted 20 May 1958

First paragraph says:

This invention relates to rims and more particularly to multiple piece rims for use with large size tubeless tires.

U. S. Patent 3,003,538

Application filed 22 May 1959
Patent granted 10 October 1961

First paragraph says:

This invention relates to a rim and more particularly to a rim driver to provide a positive means to prevent slipping between the bead seat ring and rim base due to the torque encountered in the vehicle operation.

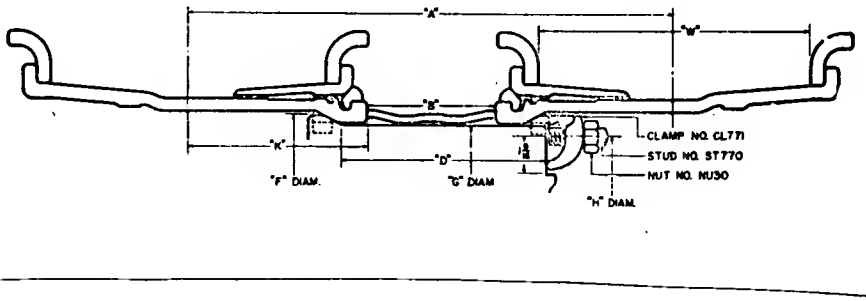
U. S. Patent 3,599,697

Application filed 21 August 1969
Patent granted 17 August 1971

Abstract says:

A multipiece wheel rim having a special driver lug assembly, having a pair of circumferentially spaced-apart lugs mounted on a bead seat ring to engage a member attached to the rim base of a wheel rim and prevent circumferential movement of the bead seat band on the rim base when the rim is used on a vehicle. The driver lugs are so designed and positioned that they permit substantially uniform radial flexing of the bead seat band thereby preventing undesirable stresses at any given location on the bead seat band.

Exhibit A2 -- Information on U. S. Patents relating to wheel assemblies of the type shown in Exhibit A1.

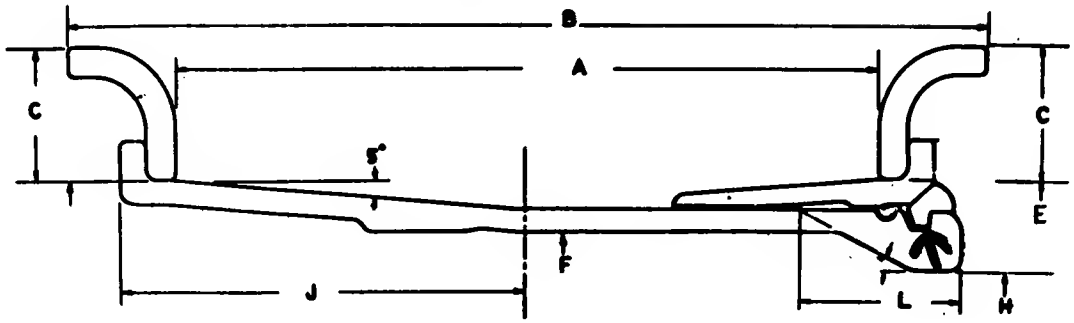



Some dimensions, inches

| W | A | B | D |
|---|---|---|---|
| Nominal Rim Width | Dual Spacing | Spacer Width | Wheel Width |
| 15 | 24 5/8 | 6 | 9.015 |
| 15 | 25 3/8 | 6 3/4 | 9.765 |

Exhibit A3--Mounting of dual wheels

Two assemblies of the type shown in Exhibit A1 are required. The inboard tire-ring assembly, (left in diagram) is placed so that the mounting bevel bears against a shoulder on the wheel. Note that the lock ring side of the rim base is at the wheel. A spacer ("B" width) is placed between the wheels. The second (outboard) assembly is placed so that its lock ring faces that of the inboard assembly. The stud-clamp-nut combination exerts force against the mounting bevel of the outboard rim base to hold both assemblies in position.




| Component | Weight pounds |
|---|---|
| rim base | 340 |
| flange | 82 |
| bead seat | 96 |
| lock ring | 16 |
| "O" ring | 1/2 |
| complete assembly (without tire) | 615 |
| complete assembly (with tire) | about 2000 |

| Dimensions inches | |
|---|---|
| A | 15.000 |
| B | 17.500 |
| C | 3.000 |
| D | 9.313 |
| J | 8.687 |
| Dia E | 35.000 |
| Dia F | 32.625 |
| Dia H | 30.812 |
| Overall diameter (with tire) | about 6 ft |

Exhibit A4 -- Some specifics of failed assembly, a 15x35 earthmover rim.

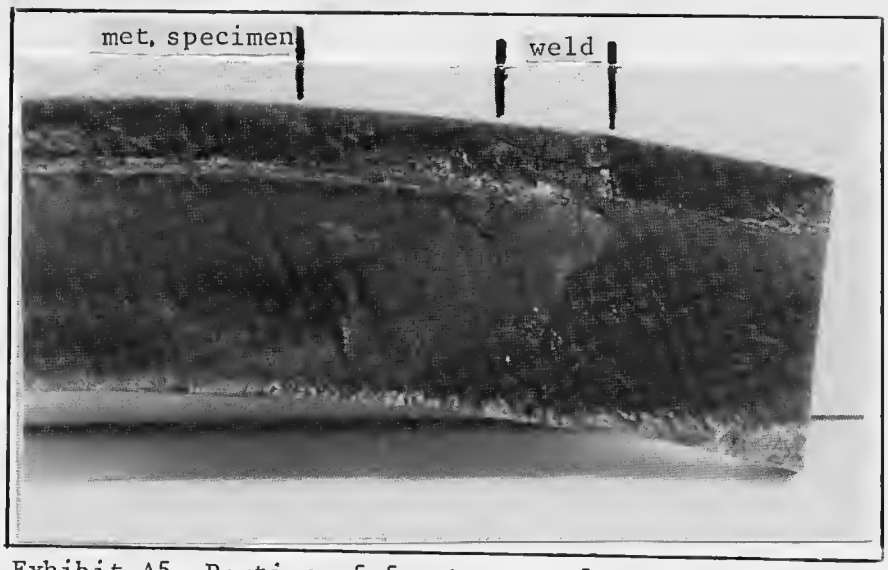



Exhibit A5--Portion of fracture surface. A crack is visible (made visible by magnetic particle inspection) in the unfractured surface of the gutter. This crack is located at the weld in the rim base. Approx. 1.2X

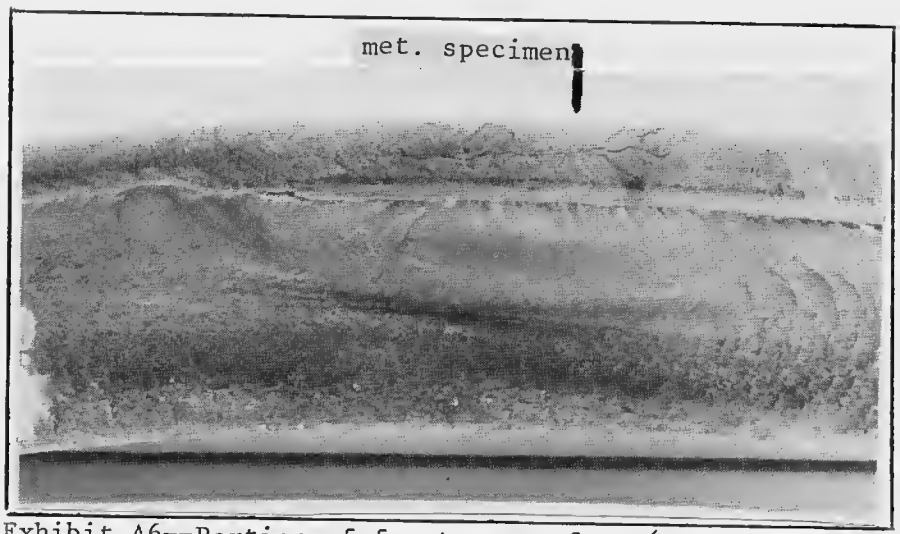
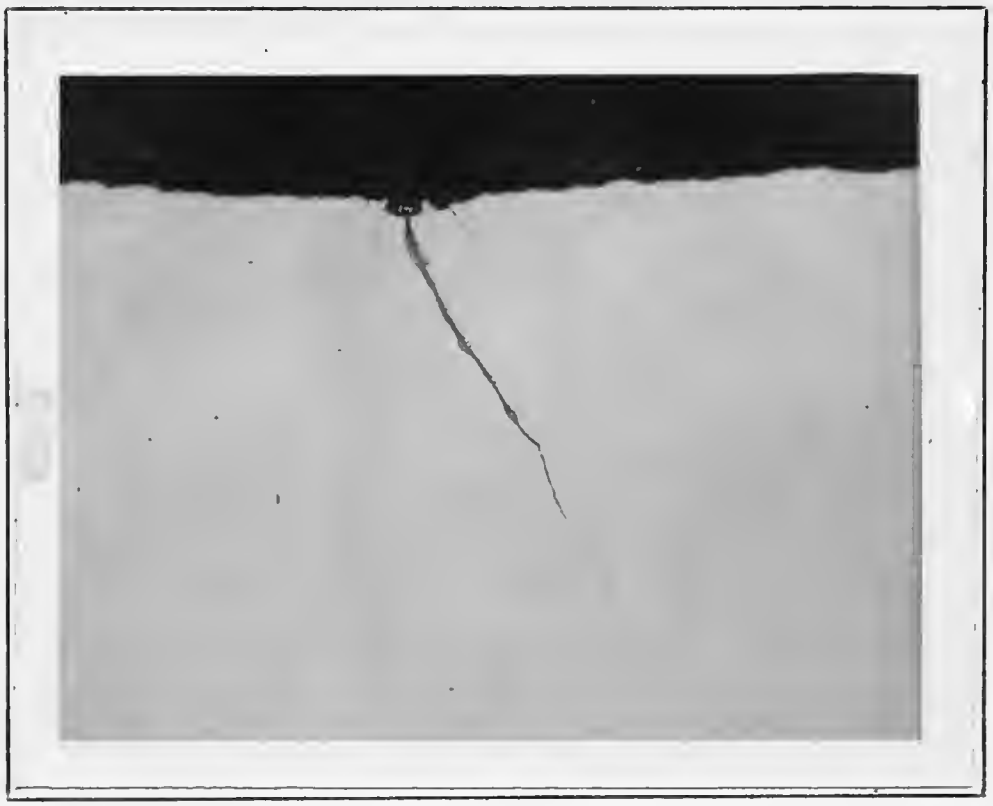
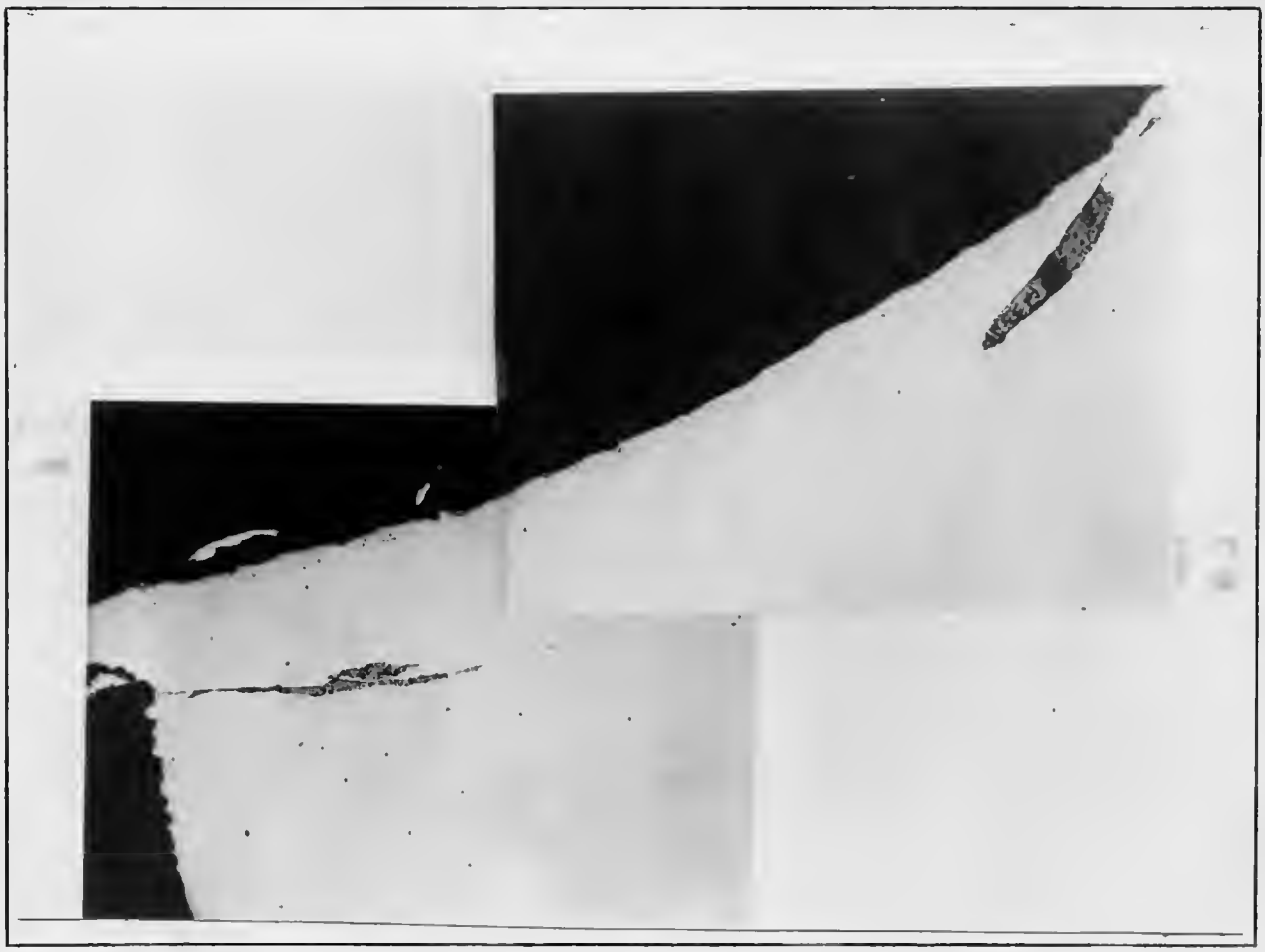



Exhibit A6--Portion of fracture surface (center about 10 inches from weld in rim base). A crack is visible (made visible by magnetic particle inspection) in the unfractured surface of the gutter. Approx. 1.2X



Polished - unetched 72X

Exhibit A7 -- Metallographic specimen (MS1) (taken from separated ring as shown in Exhibit A6) showing an imperfection extending from the gutter surface into the body of the separated ring.



Polished - unetched 72X

Exhibit A8 -- Metallographic specimen (MS1) showing inclusion under gutter surface (upper right) and an inclusion starting at the fracture surface (left) and extending under the gutter surface. When viewed under a higher magnification these two inclusions appear to be connected.

2% Nital 72X

Exhibit A9 -- Metallographic specimen (MS2) taken from the separated ring as shown in Exhibit A5 showing a seam, fold, or thin inclusion extending from the fracture surface (at left) under the gutter surface.

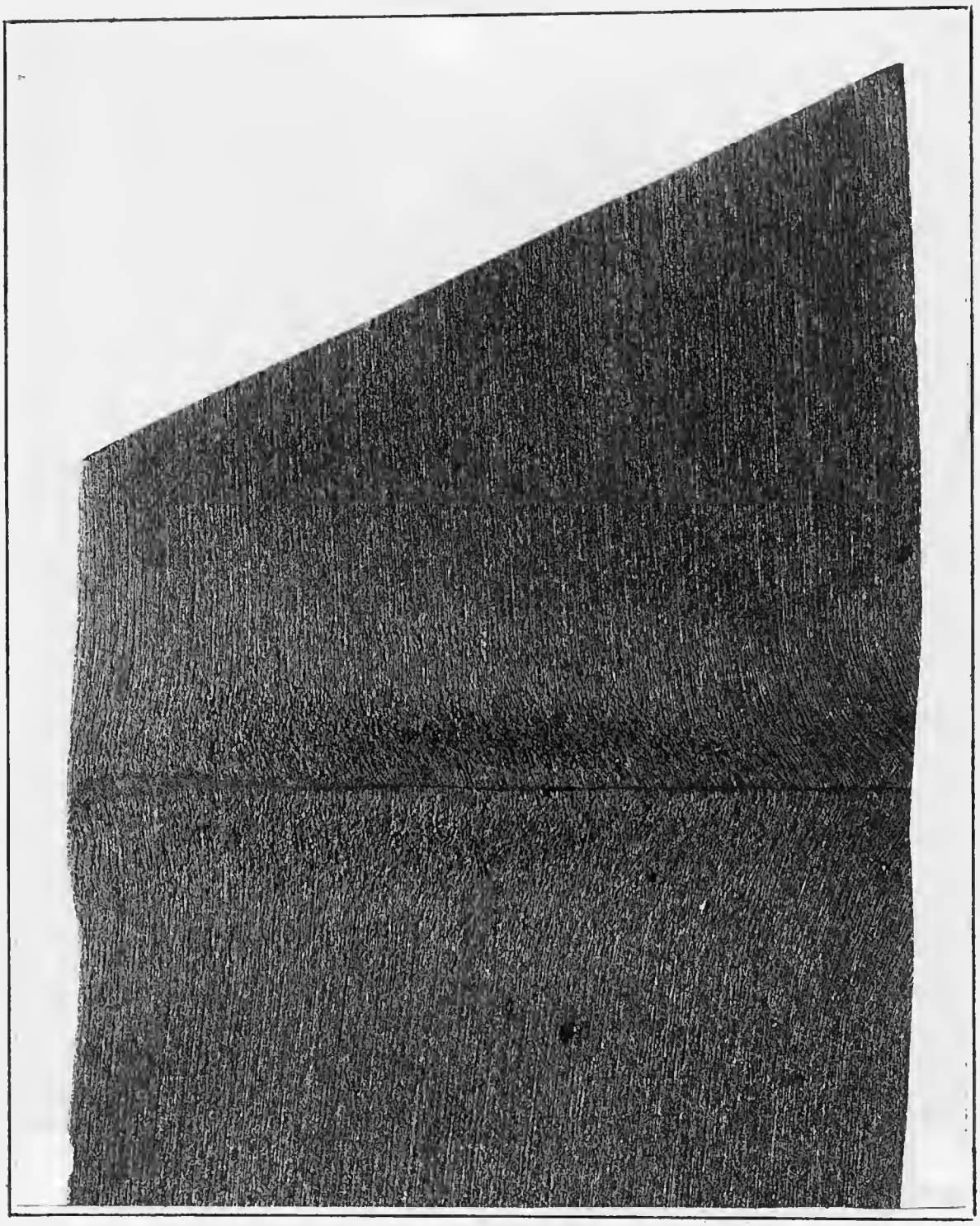
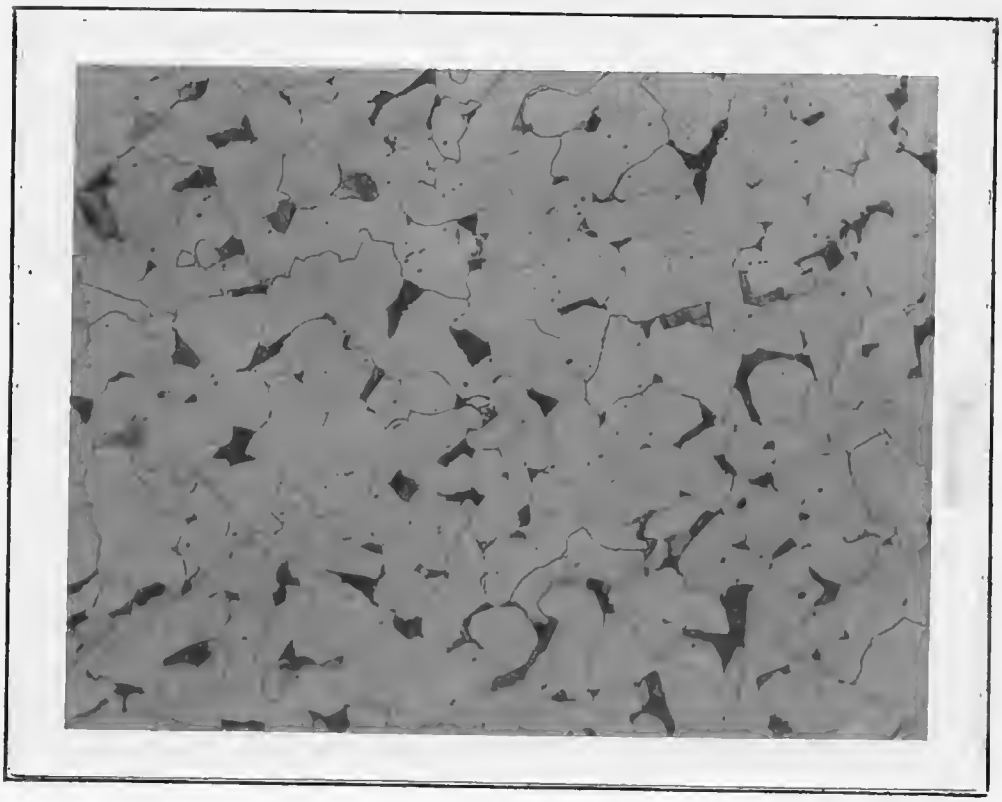


Exhibit A10 -- Photomacrograph of cross-section of weld in rim base showing flow lines in plate, flow lines at weld interface, and interface between the two sections welded together. Approx. 4X



2% Nital 250X

Exhibit All -- Typical microstructure of rim base (taken from MS2) showing pearlite in a ferrite matrix.

Exhibit A12 -- Fracture surface of the tapered bead seat. The shoulder end shows some rust and some points where rubbing may have occurred. Center section is darkened, perhaps by minor oxidation. Tapered section is bright and shiny. Both the center and tapered sections appear to have failed rapidly. Approx. 1.15X

Exhibit A13 -- Oblique view of fracture surface of tapered bead seat showing the weld at the location where the flange retaining shoulder joins with the rest of the bead seat. A crack and a void in the weld are obvious. Approx. 2X.

## THE RAMBUNCTIOUS RIM (B)

Presumably as a result of Mr. Faber's preliminary report, Jack Cash filed suit against the Metal Products Division of MYTIRE (manufacturer of the assembly) which in turn sued GUTSTAHL (the steel supplier) as a third party defendant.

### Interrogatories

Once suit is filed, each party to the suit is entitled to pursue the discovery process which includes submitting interrogatories (questions) to any (or all) of the other parties. These questions must be answered under oath and allow all parties to determine those items on which there is agreement (or disagreement).

In November 1973 in response to interrogatories, MYTIRE claimed that Jack Cash was the only person of whom they had knowledge that claimed to have been injured while using a rim of this size. Two persons had been killed and two others had been injured while using rims of the same basic type in larger size. The two killed were separate incidents in which the man was removing the dual assembly to change a flat on the inner dual. In both cases, MYTIRE noted that the man had failed to deflate the outer dual. The two injured men were involved in the same incident in which they were removing a dual assembly because the tread was coming off the inner dual. In this case, they deflated the outer dual but failed to deflate the inner one.

One question addressed to MYTIRE was: "Has the defendant received any complaint of wheel failure as to this model from anyone? If so, provide full information." The response was: "Information has been provided above with respect to all claims we know about involving bodily injury allegedly resulting from failure of this general type of rim. It is impossible to answer this interrogatory with respect to failure generally since the pattern of usage of this type of rim involves keeping it in service until a fatigue failure occurs in the form of cracking or breaking which renders the rim unfit for further service or which requires repair before it can be continued in service."

(Faber had been retained by Cash's attorney. He commented: "It seems to me that MYTIRE is saying that the users in the field continue use until the rim is no longer serviceable and must be repaired or replaced. I submit that there is no way, without very careful, regular, painstaking inspection, in which one can predict when a component, such as one of these rims, will fail. Granted: failure will undoubtedly most often occur in actual field operation. But that does not, by any means, eliminate the possibility of just what happened in Cash's case. This strikes me as another form of Russian roulette.")

In November 1973, Cash's employer turned over two additional rims of the same general style to Faber. One rim was identical to the one

involved in Cash's injury, -- made by MYTIRE, having the same model number. The second rim was the same in all essential details but apparently was fabricated by a different manufacturer. In the case of the identical rim base, a portion was separated over about 1/3 of the circumference. There also appeared to be a crack for some additional distance along the circumference. The fracture surface was along the gutter and the appearance of the fracture surface was highly similar to that of the rim base examined in the summer of 1972 (See Exhibits A5 and A6). At one region of the circumference, there was a crack, starting at the gutter, which had progressed completely through the steel. No examination, other than visual, was made of this second rim base but the observations were so similar that Faber concluded the causes were highly likely to be similar.

Defense Experts

In October 1974, attorneys for all three parties and technical experts for MYTIRE and GUTSTAHL met and examined the various pieces of the rim involved in the Cash injury. (Only Cash's attorney was aware of the existence and examination of the second rim.)

MYTIRE retained Mr. Redwine, an independent metallurgical expert. In January 1975 he wrote MYTIRE's attorney as follows:

> The results of my study can be summarized as follows:
>
> There is a seam or fold containing inclusions starting from the fracture surface and running under the fillet or ring groove surface. The size and number of oxide inclusions which are contained in the seam or fold varies from sample to sample. X-ray probe analysis of the inclusions shows only iron to be present as the metallic element in the inclusion. Because the same type of structures are present regardless where the samples are taken from the rim sections, the seam or fold must run the entire length of these rim sections.
>
> The photographs representing my observations are taken with the scanning electron microscope and are marked with a "B" or "2" to represent the appropriate rim sections. The low magnification photographs show the seam running almost parallel to the fillet surface and extending into the fracture surface which in turn intercepts the fillet surface in a point. The higher magnification photos show more clearly the inclusions present and the degree of continuity of the seams.
>
> I have prepared the weld sample in a similar manner and evaluated the structures present. I find minimal porosity, the heat affected zone is sound, and hardness measurements across the weld give acceptable values.

GUTSTAHL, in contrast, chose to rely on a metallurgist, Mr. Light, who was a full time employee. His chemical analysis confirmed that the steel was an AISI C1010, as specified, and within normal acceptable limits. As a result of his visual inspection, Mr. Light said there was "clam shell fracture appearance characteristic of a fatigue-type failure under cyclic loading. Fracture initiated on the outside gutter. (Exhibit A5) Final brittle fracture across tapered bead seat appeared to have been initiated by the fatigue crack." As a result of metallographic examination, Mr. Light reported that: "A lap was observed in all polished samples along the outside gutter leading up to the fracture as shown in Exhibit A8. Hot rolled scale was evident in the lap area.-- The lap was located from 0.015/0.025 inch below the rolled surface of the gutter and was 0.1 to 0.15 inch in length along the rolled surface of the gutter. --- Although the fatigue fracture initiated at surface along the lap, the crack path only coincides with the lap for a distance of about 0.05 to 0.1 inch. The crack then propogates into the steel away from the remainder of the lap. --- The upset weld sample was polished and examined microscopically. A 1/8 inch length along the fusion line was unbonded with two large silica particles included in the unbonded part along the fusion line which appeared to have been embedded during the welding operation."

Questions:

1. Now that there are statements from experts representing all three parties to the suit, on what do they agree? On what do they disagree?

2. What is your reaction to MYTIRE's apparent attitude toward field failures of these rims?

3. What conclusion have you reached in terms of how this case should be handled at this point? Why?

## THE RAMBUNCTIOUS RIM (C)

Plaintiff's First Supplemental Interrogatories

Cash's attorney asked further questions of MYTIRE in February 1975, relative to inspection and testing procedures. The response in May 1975 indicated that inspection of welds was visual after the parts were expanded and processed. There was also a statement that "The sizing operation expands the gutter section beyond the yield strength of the material, thereby testing the strength and integrity of both the parent material and the weld." (Faber commented that "one might argue that such yielding at the location of a defect such as a lap, seam, or fold could indeed initiate the fatigue failure by causing the first small crack which would then propagate under field operation.")

MYTIRE would not admit that the rim failed and caused Cash's injury as alleged. There was agreement, however, that it appeared that the gutter section of the rim broke at some time as a result of a fatigue crack originating from a lap in the metal.

MYTIRE took the position that Cash was negligent in (1) attempting to remove one or more of the duals without being certain that the tires were deflated and all air exhausted from them, (2) failing to follow manufacturer's suggested directions and instructions for removal of duals, (3) failing to first remove the valve core before removing nuts and clamps, (4) using improper tools, (5) using one or more hammers or tools which were not suitable for the purpose of removing duals, and (6) standing between the dual assembly and the tire repair truck while attempting to remove the dual assembly.

The following quotations may be of interest:

Question: What is the manner of use of the removing and replacing an inner dual rim and tire by the average user?

Answer: Removal

(1) Raise tires off ground in proper, safe manner.
(2) Remove the valve cores and exhaust all air from both tires of the dual assembly prior to removing any rim components such as nuts and rim clamps. Check valve stem by running a piece of wire through the stem to make sure it is not plugged.
(3) Attach sling, hoist or other devices to be used in handling tire-rim assembly.
(4) Remove nuts, clamps, and wedge band.
(5) Remove outer tire-rim assembly with sling or other lifting device.
(6) Remove spacer band.
(7) Remove inner tire-rim assembly.

Replacing: Reverse above procedures.

Question: What are the abnormal ways an inner dual tire and rim is removed and known by you to be so used?

Answer: Not deflating both tires of the dual assembly.
Improper jacking of vehicle.
Improper use of hoists and handling devices.

Question: What is your experience regarding the normal or expected life of the rim?

Answer: Life of a rim depends upon service conditions such as load, speed, inflation pressure, nature of haul road, etc. and upon the type of maintenance performed on the rim assembly.

There was also reference to "publication and dissemination of literature and posters and oral instruction by MYTIRE personnel." A major evidentiary exhibit was two pages of "Operating Instructions" (for two somewhat different rim assemblies). Relative to demounting, one had this statement: "CAUTION: Always deflate tire completely by removing valve core from valve before attempting any dismounting operating." (The other was identical except that it said "operation rather than "operating.") When Faber was asked to comment, he said: "While it is true that the statement does say "any dismounting operation," it is also obvious that everything else on both sets of instruction refers specifically to tires and all the pictures on both sets clearly relate to mounting and dismounting of tires. It seems obvious that any reader would infer application to tires and would not be likely to draw any inference of applicability to dismounting of a rim-assembly from a vehicle in the field."

How New a Problem?

It appears that MYTIRE took the position that the problem of these fatigue failures was relatively recent and, in any event, was not very significant since there were no complaints from users of their rims. But was it a new problem? In the course of the discovery process, it developed that GUTSTAHL had conducted an investigation and written a report "Fatigue Tests of Tire Rim Samples for MYTIRE," dated 3 August 1962. In part, this report said:

> "In service, these rims are subjected to repeated dynamic loads and "shock" overloads. MYTIRE has experienced rim breakage problems with the "Gutter" section which were clearly fatigue failures originating in the lock ring groove. The type of failure indicated that the most damaging part of the load may come from sidewise thrusts of the lock ring against the wall of the groove. On a trial basis, and at their customer's request, they have furnished this rim of Mayari R40 steel instead of C1010 steel.

However, it was questionable whether these low alloy high strength rims would provide any better service life.

MYTIRE would like to overcome these failures and at the same time make higher quality rims at lower costs. As one phase of an over-all program, MYTIRE is seeking practical, comparable data on fatigue strength of selected materials. (Changes in design and fabrication or processing procedures might also be investigated.)"

The overall conclusion was that little improvement in fatigue strength of the product could be expected by substitution of Mayari R40 for C1010.

Somewhat later, GUTSTAHL conducted another investigation for MYTIRE and wrote a report, "Fatigue of Large Wheel Rim Lock-Ring Gutters," dated 4 February 1970. In part, this report said:

"A fatigue testing procedure is described that simulates large wheel rim service behavior to the extent that the large majority of laboratory failures were initiated in the same region as the service failures. Fatigue failure was defined as complete separation of the specimen into two pieces. The fatigue failures of rims in service are generally initiated in the outboard radius of the lock ring gutter."

The basic objective was to determine the effect of shot-peening on fatigue resistance of C1010 in a large rim base. The conclusion was that there is some improvement in fatigue life from shot-peening under certain conditions.

When asked by Cash's attorney for comment, Faber said (December 1975):

"It is obvious to me that MYTIRE was well aware of service failures in fatigue at least as early as 1962. Both GUTSTAHL reports support that position, as both reports had the objectives of seeking to improve fatigue life.

It appears that both reports were based on tests conducted on steels which were free of laps, seams, or other defects. This I would fully expect. At the same time, the presence of laps, seams, or other defects in the steel, whether tested in the laboratory or in use in field operation, would substantially reduce fatigue strength for a given life. Conversely, their presence would reduce the life for a given level of applied stress. This would apply to either set of comparisons covered by the two reports, i.e., shot-peening vs no shot-peening and Mayari R40 vs C1010.

It also appears that fatigue of the kind observed in the rim failure in the Cash case would be no surprise to MYTIRE even in

the absence of any laps, seams, or other defects in the steel. The presence of such defects simply makes the steel more vulnerable to fatigue failure in a much shorter period of use.

It appears to me that the testing procedures, observations, and results reported in these two GUTSTAHL reports are quite consistent with the analysis and position taken by our investigations and analysis of the failure in the Cash case.

It appears to me that, despite MYTIRE's concern indicated by the report of 3 August 1962, little progress has been made in improving the situation. It appears to me that the design of the rim base with the lock ring gutter is essentially the same (if not identically the same) in the Cash case as it was April 1961 (MYTIRE drawing No. 812332)."

Questions:

1. How do you view the technical information which has now been presented? What seems valid? What invalid? What conclusion have you reached on a technical basis only? Why?

2. What conclusion have you reached in terms of how this case should be handled at this point? Why?

## THE RAMBUNCTIOUS RIM (D)

Trial Testimony Highlights

All the information in Parts A, B and C was in the hands of all three parties by January 1976. Cash's attorney believed he had a strong case and was urging MYTIRE to settle out of court. He really had no interest in the action between MYTIRE and GUTSTAHL. So far as he was concerned, the rim assembly was a MYTIRE product and MYTIRE's responsibility. Whether MYTIRE or GUTSTAHL was ultimately responsible was of no concern to him. He had some concern that his presentation of the case was complicated by having GUTSTAHL as a third party defendant rather than only action between Cash and MYTIRE. Despite his urging, MYTIRE declined to settle but chose to let the matter be decided in a courtroom before a jury. Trial was held in July 1976 in a U. S. District Court.

Jack Cash testified that he was gone about 45 minutes in getting the replacement tire-wheel assembly. He did not deflate either tire although he had put only about 50 psi in the flat tire when he had checked it earlier. He did not hear any escaping air when he returned with the replacement. He jacked up the earthmover so that the wheel was about 6 inches above the ground. He rigged the hoist and sling so that the hook was about 6 inches above the center of the tire so there would be no binding of the assembly on the wheel. He further testified that, when he could not loosen the outer assembly after removing the nuts and clamps, he tapped the outer assembly with a rubber mallet. He testified that "the next thing" he knew, he was conscious of being pinned against the repair truck with the outer dual resting against him.

There were no eyewitnesses. There were other workers in the immediate area who came running to the site. Some of these testified that the repair truck (which weighed 16,000 to 18,000 lbs) had been moved laterally a distance of about 4 to 5 inches.

It was clear from the testimony that there was no question that Jack Cash was injured. MYTIRE's attorney, through cross examination, sought to convince the jury that Cash had indeed been negligent.

The technical witnesses, Faber and Redwine, testified in keeping with their reports on their examinations. The substance of these data has been given in Parts A, B, & C. Much attention was paid to the gutter surface and the possible presence of a seam or lap which led to the fatigue failure. Since there had been separation around the entire circumference of the rim base, the presence of a lap or seam was not very obvious.

Faber and Redwine agreed on its presence, however. Exhibit D1 (taken from one of the duplicate rims discussed in Part B) shows the

lap or seam on the gutter surface in a section next to one in which there had been separation in the rim base. Faber and Redwine agreed that such an imperfection in the gutter surface could, and very likely did, lead to a fatigue failure in the rim base.

A middle management employee of MYTIRE agreed with Faber and Redwine on the effect of the lap or seam. It was made clear that GUTSTAHL rolled the gutter into the flat section of the rim base before delivery to MYTIRE. Although it was claimed that GUTSTAHL was responsible for the lap or seam, it was admitted that the lap or seam should have been detected by visual inspection and this specific rim should never have gotten out of the shop.

Questions:

1. What is your summary of the technical aspects of the evidence?

2. How credible is the testimony that the repair truck was pushed sideways for 4 to 5 inches?

3. What can be done to eliminate (or at least minimize) the problem of fatigue in rim bases of this general type?

4. If you were a member of the jury, would you come back with a verdict and monetary award for the plaintiff or would you come back with a verdict of "no cause", i.e., failure by the plaintiff to convince the jury of his case?

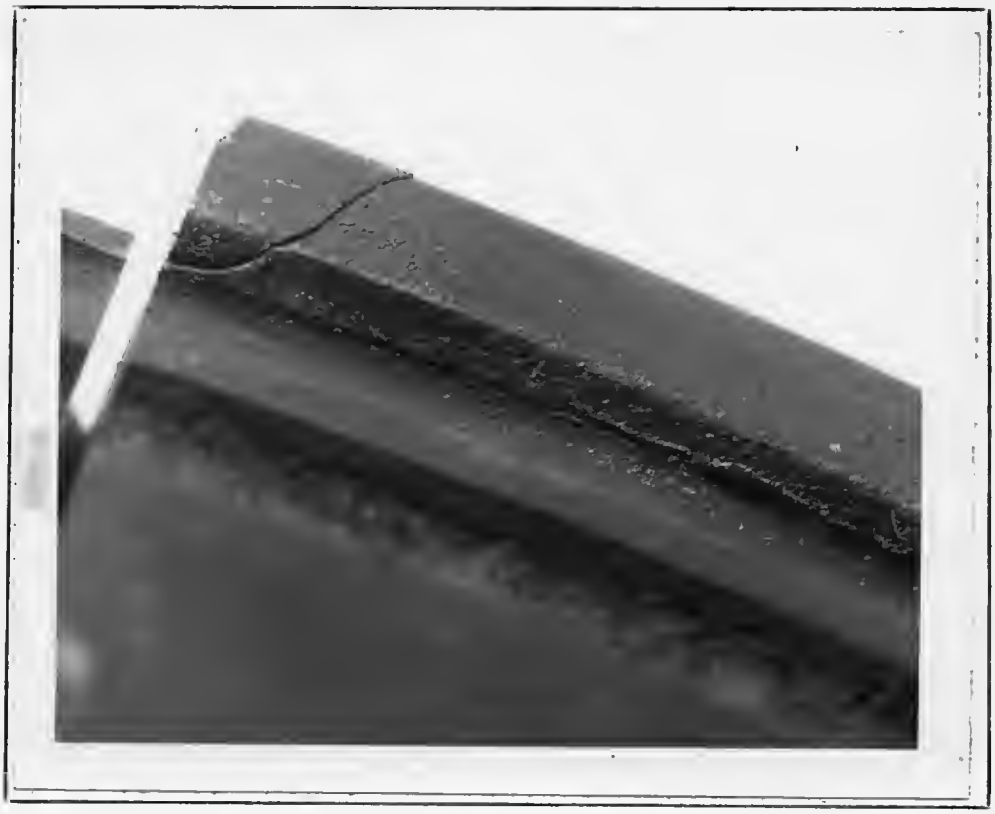


Exhibit D1 -- View of part of the gutter section of a rim base. The presence of a lap or seam is obvious on the gutter surface. A crack is also obvious. This crack is part of a separated surface to the left of a saw cut. The crack appears to be directly in line with the lap or seam.

## THE RAMBUNCTIOUS RIM (E)

Jury Finding

After relatively short deliberation, the jury returned to the courtroom with a verdict on behalf of the plaintiff with an award of $450,000 to be paid by MYTIRE. Cash and his attorney were quite delighted as they would gladly have accepted an out-of-court settlement of $150,000.

It might be noted that while there was no question that GUTSTAHL was responsible for the faulty tool used in rolling the flats for rim bases, this did not relieve MYTIRE of any responsibility for further inspection. The fact that MYTIRE had done additional processing on the rims was ample evidence that MYTIRE had an obvious opportunity to inspect and detect the lap or seam which could have been detected by visual examination.

Comment

Some months after the trial, Faber and Redwine were discussing the case. They were highly skeptical of the testimony relative to the sidewise movement of the truck. They did not believe there was enough energy left in the inner dual to do this. It was their feeling that the witnesses had confused tire marks made by Cash on the first trip to the earthmover with the final position of the repair truck. From a somewhat different view, they found it difficult to believe, if it were true that the repair truck did indeed move sidewise as alleged, that Cash only lost a leg since the force from the outer dual had to be transmitted through Cash to the truck. They suspected that the outer dual may have slipped from the hoist/sling and caused the injury. Obviously, this is a separate issue from the fatigue failure.

Both Faber and Redwine wondered why this case went to court since the technical evidence was so clear with all parties in substantial agreement on the observations and interpretations. Lawyers generally agree that a case should go to the courtroom only when the evidence and interpretation by opposing parties is conflicting. It is recognized, however, that some companies appear to have a policy of "fighting" every case, no matter what the evidence.